Early and Late Perseids. By W. F. Denning.

The following is a list of the apparent paths of probable and possible Perseids observed at Bristol during the 16 nights July 7 to 22 and 9 nights August 17 to 25 inclusive in the thirty years from 1876 to the present time. A proportion of these meteors were undoubtedly not true Perseids, but belonged to the other showers existing in Cassiopeia, Andromeda, Pisces, Aries, Camelopardus, Taurus, Auriga, etc., at the same epoch. There are a great number of such radiants visible—certainly more than a hundred—and it is very difficult to attribute correct positions for some of the individual meteors which have appeared at this time of the year.

The materials here furnished may afford some help in determining the dates of beginning and ending of the Perseid shower. These are very doubtful at present, but I believe that the weight of evidence favours the conclusion that true Perseids may be occasionally recognised after the first week in July. The display is very feeble at that time, and may not supply one meteor during a watch of several hours by a single observer. But on July 19 the stream becomes well pronounced, and its radiant capable of being definitely ascertained, though not in every year. The date just mentioned is in fact the earliest one on which I can confidently say that Perseid meteors are sometimes visible in sufficient numbers to enable a good radiant to be obtained by an individual observer.

In the last column of the list I have ascribed the radiants as they appear in my MS. book of observations. These positions are not correct in all cases. But I have reprojected the apparent paths, and have affixed the letter P to distinguish those which may be regarded as Perseids.

If other observers will supply similar data it will be possible to deduce the place of the radiant on every night from July 7 to 22. But it cannot be safely said that the shower begins so early as July 7; it will be very difficult to learn when the earth really encounters the first shots from this widely-distended stream.

Further materials for the above period, and for the concluding stages from August 17 to 25, will throw an interesting light on the actual duration of the shower, and on the positions of the radiant near the limiting dates of its visibility.

We might soon determine these features but for the fact that there are many other secondary displays yielding similar meteors and radiating from the same region of the sky. It is often impossible to say whether meteors are Perseids or not, though their flight-directions may conform with the position of the great August shower. At the earlier stages of the display there are well-defined minor radiants at about

23°+43°	33°+52°	50°+31°
23+57	43+22	54+71
29+36	44+57	60+58
33+18	47+43	61+48

—and many others, varying in strength from year to year.

With regard to the concluding phases of this system, I have recorded meteors from the right position up to August 25, but there are doubts as to whether the shower is really prolonged to that date. It is certainly continued to August 20, but on subsequent nights the evidence gleaned is not sufficiently ample to enable one to absolutely affirm its visible continuance. From a discussion of my combined observations in various years, I have deduced the following radiants of Perseids :—

Aug. 16	53°+58°	21 ↓ *s*	Aug. 20	57°+59°	10 ↓ *s*
,, 17	54+60	5 ,,	,, 21	64+59	12 ,,
,, 18	55+59	11 ,,	,, 22	70+61	7 ,,
,, 19	57+59	5 ,,			

Companion showers (in addition to those above given for the earlier stages) are well pronounced at about—

39°+28°	70°+66°	75°+15°
58+ 9	71+52	77+32
61+36	74+42	87+43
63+22	77+58	106+52

The earliest radiant I have obtained, presumably for the Perseids (though a shower of Cassiopeids may also be involved) is for the period July 7–9, 10° + 45½°, ten meteors. Quite possibly the shower continues during fifty nights July 7–August 25.

The late Mr J. Kleiber gave the theoretical place of the Perseid radiant as, on July 8, 9° + 46°, and August 16, 54° + 59°—(*Monthly Notices*, lii. p. 351).

Observed Paths of Early Perseids.

Date.			G.M.T. h	m	mag.	From α	δ	To α	δ	Path.	Notes.	
1877	July	7	13	21	2	349°+25°		345°+20°		6½°	R K	P
1902		,,	11	44	3	318+56		283+49		22	R K	P
1885		8	12	1	½	240+61		218+37		27	v R B K	30+8
1888		,,	11	4	4	47+71		87+73		12	R	345±0
		,,	12	7	4	61+59½		81+70		7	R K	
		,,	12	36	3	355+22		349¾+10½		11½	R K	P
		,,	13	22	2	332+72½		320+75		4½	R B K	P
1902		9	13	11	3	310+20		303½+14½		8	R K	P
1877		11	11	18	2	339+26		316+3		31	v RK	47+43
1885		,,	11	62	2	278+45		260+32		18	v R	P
1888		,,	11	36	3	344+58		334+59		5½	S B K	P
		,,	11	49	4	344+59½		333+61½		6	S K	P

Observed Paths of Early Perseids—continued.

Date.		G.M.T. h m	mag.	From α δ	To α δ	Path.	Notes.	
1904 July	11	14 14	2	18°+36°	20½°+32½°	4°	R K	P
1877	12	11 43	3	335+48	313+40	17	R	47+43
	,,	11 57	3	336+30	313+11	28	v R	P
	,,	12 17	3	340+64	308+66	13	v R K	23+43
1885	,,	11 18	3	281−15	275−21½		S K	P
1888	,,	12 5	3	44+58½	54+60	6	R K	P
1885	13	12 9	2	293½+35½	276½+20	21	v R K	P
	,,	12 49	3	356+41	350+37½	6	R K	P
	14	12 35	3	324+64	279+62	20	v R B K	P
1901	15	13 5	>1	270+53	248½+32	24	R K	23+43, 29+36 P
1876	16	11 17	1	260+80	225+67	15	R K	23+43, 47+43
	,,	11 33	2	310+51	286+35	22	v R K	P 47+43
	,,	12 19	2	321+42	304+30	17	R B K	P
1898	,,	11 4	3	24+53	26+57	4	S K	P
1902	,,	13 47	5	15½+55	14½+58	3	R K	20+43 P
1898	,,	12 12	3	348+53	339+53½	5½	R K	23+43
	,,	12 42	4	8+66	0+71	6	S B K	23+43
1898	17	12 42	4	25½+54½	27+59	5	R K	23+43
1876	18	10 35	4	16+47	15+40	7	R	27+71
	,,	11 20	>1	211+49	206+18	31	R K	P
1881	,,	11 9	1	110+70	144+58½	19	R K	P
1887	,,	11 1	>1	3+34½	0+31	4	S B K	P
1900	,,	10 38	5	314+46½	306+42	8	R K	P
1876	*19	10 58	½	346+25	337+12	20	B K	P
1887	,,	11 43	1	358½+38	351+30	10	S B K	P
	,,	12 25	1	350+62	330½+64	10	S B K	P
	,,	13 8	4	356+47	347+44	7	R K	P
1900	†,,	11 43	½	344+33	329+18	20	R K	P
1901	,,	11 41	1	335+68	289+67¼	12½	v R K	23+43, 29+36
	,,	12 58	4	346+35	339½+30	7	R K	P
1876	20	11 29	1	341+6	335−8	15	K	P
1901	,,	11 24	4	338+60	302+58½	8	v R K	23+43, 29+36
	,,	11 59	2	328+59	292+54¼	20	v R K	23+43, 29+36
1876	21	11 21	2	344+60	315+57	15	R K	P
1887	,,	12 40	3	5+44	359½+39	6½	v R	P

* Observed also by J. Lucas, Oxford. Radiant, 22°+54°.
† Observed also by Prof. A. S. Herschel. Radiant, 17+50.

Observed Paths of Early Perseids—continued.

Date.	G.M.T. h m	mag.	From α δ	To α δ	Path.	Notes.	
1901 July 21	11 57	5	53°+62½°	70°+65½°	8°	R K	23+43
,,	12 2	5	25+36	25+32	4	R K	23+43
,,	13 40	3	311+52	297½+45	11	R K	P
,,	13 43	1	349½+15	341+1½	16	R K	P
,,	14 0	3	26+53½	31+53¾	3	S K	P
1887 22	11 2	4	6+43	1+40	5	R K	P
,,	12 21	♃	356+45	332+29	24½	R B K	P
,,	13 2	5	25+47	27+43	4	S	P
,,	13 55	3	331+77	281+75	12	R K	P
1900 ,,	11 15	2	13+55	356+59¾	10	S K	P

Late Perseids.

Date.	G.M.T. h	m	mag.	From α δ	To α δ	Path.	Notes.	
1901 August 17	15	21	2	90°+43°	98°+35°	10°	R	P
1885 ,,	10	59	4	346+59	318+46	21	R K	P
,,	12	44	4	304½+46	298½+39	8	v R K	P
1898 ,,	9	36	3	55½+69	57½+74	5	S K	P
1899 ,,	15	8	2	96+43	103+36	8½	R K	P
1885 18	13	37	3	335+37	328+27½	11	R K	P
1893 ,,	12	25	♀	330+31	315½+9	26	R K	P
,,	12	37	1	38+10	37½+1	11½	R B K	P
1901 ,,	10	28	3	327+40	320+21	23	R K	P
,,	10	54	3	329+50	313+34½	17	R K	P
,,	11	44	3	241+84	236+72	12	R K	P
,,	12	16	5	4½+10	0+2	9	R	P
,,	12	48	5	69+63½	83+65½	6	R K	P
,,	12	53	2	37+64½	25+66¾	5½	S B K	P
,,	13	4	2	245+86	236+71	15	R K	P
1884 19	11	10	3	88+59	92+59½	2½	v R	77+58
,,	11	27	3	39+68	23+70	6	K 4°	P
,,	12	21	4	341+78½	308+73¾	9	B K	P
1901 ,,	11	48	4	353½+16	348+9	9	R K	P
,,	12	29	3	22½+58½	14+57	5	S K	P
1885 20	11	41	3	28+46	24+42	5	R K	P
,,	13	55	3	352½+15	347½+6	10	R K	P

Late Perseids—continued.

Date.		G.M.T. h	m	mag.	From α	δ	To α	δ	Path.	Notes.
1887	August 20	10	1	5	356°+67°		297°+14°		64°	S K 77+58
1901	,,	10	16	>1	349+43		327½+19½		29	R B K P
	,,	10	35	3	79+56½		92+53		8	S P
	,,	11	2	4	28½+22½		25½+15½		8	R P
	,,	11	41	3	72+67½		82+71		5	S B K P
	,,	11	45	5	357½+32½		350+22		11	R K P
	,,	13	58	4	308½+50		299½+40		11½	R P
1884	21	11	25	3	16+56		3+54		8	R K 71+52
	,,	11	40	2	42+81		309+84		11	R B K 71+52
1887	,,	10	37	5	11+50½		0+44		10	R K 77+58
	,,	12	58	4	27+49		18+45½		7	R K 71+52
1901	,,	10	0	4	312½+51½		303+41		12	R K P
	,,	12	20	2	14+45		359+33½		15½	R K P
	,,	12	48	2	22½+17		16+3½		15	R K P
	,,	13	8	4	17+15		11½+3		13	R K P
	,,	15	11	5	66+36		66+31		5	R K P
1903	,,	13	4	4	30+37½		27+33		5½	R K P
1884	22	12	21	4	72+48¾		69+43½		5½	not R K 77+58
1900	,,	10	20½	3	287+78½		264+67		13	v R K P
	,,	11	39	4	17½+28		11+17		13	R K P
	,,	11	48	3	11+44¼		3+37½		8	R K P
1901	,,	10	52	4	334+62		319+52½		12	R K P
	,,	12	5	3	11½+10		7+2		9	R K P
1906	,,	11	8	>1	18+38		7½+28		13	S K P
	,,	11	9	5	345+33		336+22		15	v R K P
1884	23	11	59	1	345+19		335½+2		19½	v R K 40+59
1887	,,	12	27	3	93+62½		109+60¼		8	R K 72+62
1900	,,	11	3	4	16+22		12+16		7	R 77+58
1903	,,	11	0	4	25+27		22+21		7	not R K 70+65
1887	24	11	10	3	66+70		6+81½		17½	R K 77+58
1900	,,	9	26	2	25+51		10+42		13	v R K 77+58
1879	25	11	0	3	243+30		243¾+16		14	R K 62+35
1903*	,,	9	35	3	27+29		20+19		12	R K 79+59

Abbreviations—R, rapid; S, slow; B, bright; K, streak; v, very; P, Perseid.

* Also observed by Mr C. L. Brook at Meltham, Huddersfield.

The Electric Arrangements of an Observatory.

By W. Ernest Cooke, M.A.

A system of electric connections for the numerous instruments has been evolved at the Perth observatory of so simple and convenient a character that a description may be interesting and perhaps useful, especially to those who contemplate establishing a new observatory.

There is only one sidereal clock and one battery used for all purposes, such as chronographs, clock dials, clock control, equatorial control, chronograph control, transit keys, and small electric lights.

The battery consists of two large accumulator cells having an E.M.F. of 4 volts. There are in reality two of these used alternately, so that one may be always available. It is found advisable to change the battery at 9 a.m. daily, and to recharge the one not in use. The charging is performed very simply by means of a motor transformer, worked from the ordinary electric light supply current.

By means of a three-way switch either battery can be turned on or off, or connected with the charging transformer, instantly.

From the battery a pair of heavy mains are run round the buildings and connected to a pair of terminals in each room, wherein any instruments which require an electric current are located. These terminals are labelled A and B.

From the contacts of the sidereal clock a current passes through a relay, and the contacts made by the armature of this relay practically indicate the adopted seconds of the clock. It has been considered advisable, in the case of the clock contacts only, to use a separate battery, and two cells of the gravity type are found to give sufficient current. But even in this case a switch has been provided for substituting the current from A B if the gravity battery is out of order.

One of the terminals of the secondary contact of the relay is connected to A, and the other to a third main wire which runs round all the buildings and is labelled C. The function of the clock relay is thus to make a momentary connection between A and C at every beat of the sidereal clock.

We have thus, in every instrument room, the three terminals A, B, and C, and from these all necessary connections can be made. Thus, for a chronograph or clock dial, wires must be run direct from C B, and this gives an electric impulse every second, since C and A are joined once a second by the sidereal clock relay. For an instrument which works by means of a key, or any form of hand control, wires must be run from A B. If a chronograph be of a